

Recommendation

ITU-T Y.4560 (03/2023)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

Internet of things and smart cities and communities –
Services, applications, computation and data processing

Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities

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Recommendation ITU-T Y.4560

Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities

Summary

Recommendation ITU-T Y.4560 specifies the requirements, functional models, platforms, and deployment modes of blockchain-based data exchange and sharing for supporting Internet of things (IoT) and smart cities and communities (SC&C).

Blockchain is an emerging technology, its most important characteristics are traceable, un-erasable, immutable, and time-stamped. It is able to efficiently ensure integrity, authenticity, and auditability for all transactions. Blockchain has important impacts and benefits for data exchange and sharing in support of Internet of things (IoT) and smart cities and communities (SC&C). In most of the IoT and SC&C scenarios, it is necessary to ensure data processing, circulation, sharing and management for all trust operations and blockchain technologies can meet these needs.

History

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Blockchain, data exchange, data sharing, functional mode, Internet of things (IoT), smart cities and communities (SC&C).

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T Y.4560

Blockchain-based data exchange and sharing for supporting Internet of things and smart cities and communities

1 Scope

This Recommendation provides descriptions of blockchain-based data exchange and sharing in Internet of things (IoT) and smart cities and communities (SC&C) application domains.

The scope of this Recommendation includes:

- Overview of blockchain in data exchange and sharing;
- Requirements for blockchain-based data exchange and sharing;
- Functional models of blockchain-based data exchange and sharing;
- Platform of blockchain-based data exchange and sharing;
- Deployment modes for blockchain-based data exchange and sharing.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [b-ITU-T Y.2091]: A structured set of capabilities, which provide value-added functionality supported by one or more services, which may be supported by an API interface.

3.1.2 blockchain data [b-ITU-T Y.4052]: The data in a blockchain, such as distributed append-only ledgers, state information, permission policies, etc.

NOTE – Blockchain data may be distributed and stored in blockchain peers. A blockchain peer may store whole or part of the data in a blockchain.

3.1.3 blockchain peer [b-ITU-T Y-Sup.62]: A functional entity or physical entity (e.g., device, gateway and system) which utilizes blockchain-related functionalities (e.g., executing transactions, and maintaining the blockchain data) in peer-to-peer communications.

3.1.4 blockchain platform [b-ITU-T Y.4464]: A platform (or system) that is established based on blockchain-related technologies.

3.1.5 blockchain transaction [b-ITU-T Y.4052]: An operation (e.g., deploying, invoking, and querying results of blockchain contracts) in a blockchain in which an authorized end user performs operations (e.g., reading/writing blockchain data, invoking a blockchain contract).

3.1.6 closed data [b-ITU-T Y.4052]: Data that requires access control to be divulged.

3.1.7 consensus [b-ITU-T Y-Sup.62]: Agreements to confirm the correctness of the blockchain transaction.

3.1.8 data asset [b-ITU-T X.1750]: An electronically recorded data resource, owned or controlled by an organization.

3.1.9 data sharing [b-ITU-T Y.4052]: The process of data exchange among different parties with specified conditions.

3.1.10 data exchange [b-ITU-T Y.4052]: Accessing, transferring and archiving of data.

3.1.11 Internet of things (IoT) [b-ITU-T Y.4000]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – From a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

3.1.12 IoT service platform [b-ITU-T X.1369]: A system platform where IoT devices are connected and IoT applications are executed.

NOTE – From a functional perspective, the IoT service platform provides capabilities of device management, connection management, application enablement and business analysis, etc. From a data management perspective, the IoT service platform collects, stores and processes data (including users' personal data and confidential information) for IoT applications and advanced analysis.

3.1.13 open data [b-ITU-T Y.4472]: Data that can be publicly accessible to all through open standards and protocols or through other means. The use and redistribution of open data can be subject to rules.

3.1.14 service [b-ITU-T Y.2091]: A set of functions and facilities offered to a user by a provider.

3.1.15 smart contract [b-ITU-T Y-Sup.62]: Embedded logic that encodes the rules for specific types of blockchain transactions. A smart contract can be stored in the blockchain and can be invoked by specific blockchain applications.

3.1.16 thing [b-ITU-T Y.4000]: In the Internet of things, an object of the physical world (physical things) or of the information world (virtual things), which is capable of being identified and integrated into the communication networks.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DPM	Data Processing and Management
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IoT	Internet of things
IP	Internet Protocol
JSON	JavaScript Object Notation
P2P	Peer-to-Peer

SC&C	Smart City and Communities
TCP	Transmission Control Protocol

5 Conventions

In this Recommendation:

- The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.
- The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement needs not be present to claim conformance.

6 Overview of blockchain in data exchange and sharing

6.1 Impacts of blockchain in data processing and management

The Internet of things (IoT) consists of a global network of billions of uniquely identifiable and addressable objects, embedded with transducers (e.g., sensors, actuators, and controllers) connected to the Internet.

The blockchain is widely acknowledged as a potential solution for enhancing current centralization, privacy and security problems when storing, tracking, monitoring, managing, and sharing data. Blockchain usually consists of one or multiple distributed ledgers which contain all transactions executed within their networks, enforced with cryptography, and carried out collectively by peer-to-peer (P2P) workgroups. The blockchain is a trust-free, tamper-proof, auditable, and self-regulating system, with no human intervention required to execute the computations.

Blockchain will have several impacts on data processing and management (DPM) to support IoT and smart city and communities (SC&C) application domains:

- Generally, IoT is used in P2P networks. The multi-centre and weak centre characteristics of blockchain are suitable for IoT networks. Additionally, blockchain can also help the central structure by reducing high operation and maintenance costs, especially when using blockchain on data exchange and data sharing.
- Consensus in blockchain would help to identify illegal nodes and prevent malicious access, thus it is good for supporting device security, and to further improve data security.
- Relying on the chain structure and distributed architecture of blockchain, it helps to break the existing data information islands of the IoT and promote horizontal flows of information and multi-party collaborations.
- As the backbone of all these interactions, blockchain creates a secure and democratized platform that is independent and levels the field for all the involved parties, making sure everyone plays fair.
- The information encryption and secure communications in the blockchain would help data security and protect privacy and identity rights management.
- Blockchain makes data auditable and traceable. Blockchain supports audit trails on data storage and data transaction, to improve the trustworthiness of the data and the data transaction. Blockchain makes data and data transactions auditable. Once the data or transaction is recorded in the blockchain, it cannot allow detection and rejection by the other nodes in the network. In addition, using timestamps, the data in the blockchain is traceable.
- Blockchain may support data monetization, where owners of IoT devices and sensors may share the generated IoT data in exchange for real-time micropayments.